A base 88 supports electrical components 90, a pump motor 92, and a heater 94. A tank 96 sits on top of heater 94, and filter 98 is located between an outlet of the tank and an inlet of the heater. A fill port 100 is connected to the top of tank 96 to allow circulating fluid to be introduced into the system. Inlet 102 also connects to the top of tank 96 and receives circulating fluid from either hose 26 or 28, and outlet 104 supplies heated fluid to hose 28 or 26.

The warming fluid is driven through the heat exchanger circuit by pump 106 which is connected to the pump motor by magnetic clutch 108.

With particular reference to FIG. 8, tank 96 includes an air vent and overflow tube 110, and a float switch 112. The float switch is in turn connected to a control circuit 114 to permit operation of the device only when sufficient fluid is present. Heater 94 comprises a tubular channel having an electric heating rod 116 therein, and the heating rod is connected to a temperature control circuit 118 which is in turn also connected to control circuit 114. As fluid flows from tank 96 through filter 98 and through heater 94, it is warmed, and the temperature is measured by temperature probe 120, which is located in the outlet of heater 94. Temperature control probe 120 is connected to temperature control circuit 118 to control energization of heating rod 116. A second temperature control probe 122 is also located in the outlet of heater 94 and is connected to control circuit 114 to ensure that the temperature does not exceed a predetermined level. If the temperature of the warming fluid is too high, the blood cells could be destroyed, and it is thus important either to automatcially shut down the heating system or to activate an alarm such as that shown at 124.

Power is provided through power cord 126, and the voltage is adjusted by an isolation transformer 128. A switch 130 activates the entire electrical system, and the operation of the system, including the fluid temperature is displayed on panel 132.

In operation of the apparatus is accordance with the invention, the unit is rolled to a location adjacent to a patient, and a sterile unit 8 is installed between fluid connectors 36 and 38. Cannula 22 is attached to the patient, and bag spikes 16 are inserted into appropriate bags containing the desired fluid to be administered to the patient. Switch 130 is activated to begin the flow of heating fluid through the heat exchanger, and after the attendant has ascertained that a desired temperature has been reached in the heat exchanger, the fluid to be administered is allowed to pass into tube 14 to be warmed by the heat exchanger. If filter 12 has been placed in the circuit, the warmed body fluid then passes through the filter and into the patient. If filter 12 is not being used, tube 18 is connected directly to the cannula 22 for direct admission of the warm body fluid to the patient.

It will be appreciated that a unique self-contained unit has been described which provides sterility by use of an easily-installed disposable heat exchanger circuit. Modifications within the scope of the appended claims will be apparent to those who are skilled in the art.

What is claimed is:

1. In combination

first and second fluid connector means for removably receiving respective first and second warming fluid ports of a heat exchanger and for facilitating passage of a warming fluid, and

support means for supporting said first and second fluid connector means,

each of said fluid connector means comprising a passageway for passing said warming fluid and means for engaging a respective said first or second warming fluid port to allow said warming fluid in said passageway to communicate with said port and to physically support said heat exchanger in cooperation with the other of said fluid connector means,

fluid circulation means for circulating said warming fluid to said first and second fluid connector means, and

temperature control means for controlling the temperature of said warming fluid,

wherein one of said first and second fluid connector means is movably mounted to said support means for movement with respect to said support means between at least first and second positions, [wherein] such that said first and second fluid connector means [are spaced by a first distance for engaging] engage said warming fluid ports when said one of said fluid connectors is in said first position and [are spaced by a second distance for releasing] release said warming fluid ports when said one of said fluid connectors is in said second position, and

wherein each of said means for engaging comprises means for removably receiving or releasing one of said warming fluid ports in a single mechanical action.

2. A combination according to claim 1 wherein said means for [engaging] removably receiving or releasing comprises means forming a recess for receiving a said fluid port.

3. A combination according to claim 2 wherein said recess includes seal means for preventing leakage of said warming fluid.

4. A combination according to claim 3 wherein said seal is an O-ring seal.

5. A combination according to claim 1 wherein said support means is elongated in a first direction, said one of said first and second connector means is mounted to said support means for linear movement in said direction toward or away from the other of said first and second connector means between said first and second positions, and said other of said first and second connector means is fixed with respect to said support means.

6. A combination according to claim 5 wherein said means for engaging comprises a cylindrical recess and wherein said cylindrical recess of said first fluid connector means is axially aligned with said cylindrical recess of said second fluid connector means.

7. A combination according to claim 2 wherein a longitudinal axis of said recess of said first fluid connector means is parallel to a longitudinal axis of said recess of said second fluid connector means, and said first fluid connector means is mounted for linear movement in the direction of said longitudinal axis.

8. A combination according to claim 7 further comprising said heat exchanger, wherein said heat exchanger comprises a central tube and an outer tube having a length shorter than that of said central tube wherein said first and second warming fluid ports comprise portions of said central tube which extend beyond

respective ends of said outer tube and said central and outer tubes form a passageway for a fluid to be warmed.

9. A combination according to claim 8 wherein said heat exchanger further comprises first and second end caps, each of said first and second end caps having a first part sealingly secured to an outer surface of a respective end of said outer tube and a second part extending away from said first part and sealingly engaged to a side of said central tube.

10. A combination according to claim 9 wherein said second portion of said cap means comprises an open cylinder in contact with said side of said central tube.

11. A combination according to claim 8 wherein said temperature control means comprises heater means in fluid communication with said warming fluid ports.

12. A combination according to claim 11 wherein said heater means comprises an electrical fluid heating element, a storage tank containing said first warming fluid, and pump means for circulating said first warming fluid in a circuit including said heating element, said tank, and said central tube of said heat exchanger.

13. A combination according to claim 12 wherein said heater means and said support means are mounted on a common wheeled base and further comprising switch means for detecting when said heat exchanger is operatively mounted on said support means.

14. A combination according to claim 13 further comprising filter means in fluid communication with said fluid to be warmed.

15. A sterile heat exchanger for controlling the temperature of a physiological fluid comprising a central tube having high heat conductivity for carrying a temperature-controlled fluid, an outer tube shorter than said central tube and surrounding a part of said central tube to form a passageway for said physiological fluid between said central and outer tubes, and first and second end caps, each of said end caps having a first part extending axially along an outer surface of said outer tube and being sealed and secured to said outer surface and a second part sealingly engaging said inner tube to ensure maintenance of sterility during operation, said second part comprising an elongate cylindrical opening engaging an outer surface of said central tube and extending away from said first part and wherein said inner tube extends beyond each of said second parts and forms two elongate connections for being slidingly received in an elongate recess.

16. A heat exchanger according to claim 15 wherein said central tube is of aluminum.

17. A heat exchanger according to claim 15 wherein said central tube has an exterior surface providing increased surface area.

18. A heat exchanger according to claim 17 wherein said exterior surface is helical and a longitudinal axis of said central tube is straight.

19. A heat exchanger according to claim 15 wherein each of said end caps includes a port for communicating a fluid to be warmed with said passageway.

* * * * *

20. In combination

first and second fluid connector means for removably receiving respective first and second warming fluid ports of a heat exchanger for receiving a warming fluid, and

support means for supporting said first and second fluid connector means,

each of said fluid connector means comprising a passageway for passing said warming fluid and means for engaging a respective said first or second warming fluid port to allow said warming fluid in said passageway to communicate with said port and to physically support said heat exchanger in cooperation with the other of said fluid connector means,

fluid circulation means for circulating said warming fluid to said first and second fluid connector means, and

temperature control means for controlling the temperature of said warming fluid,

wherein one of said first and second fluid connector means is movably mounted to said support means for movement with respect to said support means between at least first and second positions, such that said first and second fluid connector means are spaced by a first distance for engaging said warming fluid ports when said one of said fluid connectors is in said first position and are spaced by a second distance for releasing said warming fluid ports when said one of said fluid connector means is in said second position, said means for engaging comprises means forming a recess for receiving a said fluid port, said recess includes an O-ring seal for preventing leakage of said warming fluid, and wherein said support means is elongated in a first direction, said one of said first and second connector means is mounted to said support means for linear movement in said direction toward or away from the other of said first and second connector means between said first and second positions, and said other of said first and second connector means is fixed with respect to said support means.

21. A combination according to claim 20 wherein said means for engaging comprises a cylindrical recess and wherein said cylindrical recess of said first fluid connector means is axially aligned with said cylindrical recess of said second fluid connector means.

22. A combination according to claim 20 wherein a longitudinal axis of said recess of said first fluid connector means is parallel to a longitudinal axis of said recess of said second fluid connector means, and said first fluid

connector means is mounted for linear movement in the direction of said longitudinal axis.

23. A combination according to claim 22 further comprising said heat exchanger, wherein said heat exchanger comprises a central tube and an outer tube having a length shorter than that of said central tube wherein said first and second warming fluid ports comprise portions of said central tube which extend beyond respective ends of said outer tube and said central and outer tubes form a passageway for a fluid to be warmed.

24. A combination according to claim 23 wherein said heat exchanger further comprises first and second end caps, each of said first and second end caps having a first part sealingly secured to an outer surface of a respective end of said outer tube and a second part extending away from said first part and sealingly engaged to a side of said central tube.

25. A combination according to claim 24 wherein said second portion of said cap means comprises an open cylinder in contact with said side of said central tube.

26. A combination according to claim 23 wherein said temperature control means comprises heater means in fluid communication with said warming fluid ports.

27. A combination according to claim 26 wherein said heater means comprises an electrical fluid heating element, a storage tank containing said warming fluid, and pump means for circulating said first warming fluid in a circuit including said heating element, said tank, and said central tube of said heat exchanger.

28. A combination according to claim 27 wherein said heater means and said support means are mounted on a common wheeled base and further comprising switch means for detecting when said heat exchanger is operatively mounted on said support means.

29. A combination according to claim 28 further comprising filter means in fluid communication with said fluid to be warmed.